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Soil Washing as a Cleanup Method

What is soil washing?

Soil washing is a mechanical process that uses liquids, usually water, to remove chemical pollutants from soils. These chemicals usually adhere (sorb) to the surfaces of the silt or clay particles rather than to the coarser sand or gravel particles. Therefore, the purpose of soil washing is to first, separate the fine silt and clay particles from the coarser sand and gravel particles and then to facilitate the transfer of these chemical contaminants from the soil surface to the water, which can then be further treated. After soil washing is complete, several residues remain, including:

- clean sand and gravel which is nontoxic and can be used as backfill,
- clean silt and clay which is nontoxic and can be used as backfill,
- a smaller volume of soil, which contains the majority of the fine silt and clay particles, that contains some contamination and which can be further treated by other methods (such as incineration or bioremediation) or disposed of according to state and federal regulations.
- wash water, which can be treated on-site or off-site at a wastewater treatment plant, depending on the type and concentration of contaminants present.

How does soil washing work?

A simplified drawing of the soil washing process is illustrated in Figure 1 (shown on last page). The first step of the process is to excavate the contaminated soil and move it to a staging area where it is prepared for treatment. The soil is then sieved to remove debris and large objects, such as rocks, which can be disposed of on site, if free of contamination. The remaining smaller-sized soil material enters a soil-washing unit, in which the soil is mixed with a washing solution and agitated. The washing solution may be simply water or may it may be water-containing additives, such as detergent or acid, which help to remove (solubilize) the contaminants from the soil. After the washwater is drained from the washed soil, the soil is rinsed with clean water.

A Quick Look at Soil Washing

- **Separates fine-grained particles (silt and clay) from coarse-grained particles (sand and gravel).**
- **Significantly reduces the volume of contaminated soil.**
- **Is a relatively low-cost alternative for separating waste and minimizing volume required for subsequent treatment.**
- **Is a transportable technology that can be brought to the site.**

After washing, the heavier sand and gravel particles in the processed soil are allowed to settle out and are tested for contaminants. If clean, this material can be used on the site or taken elsewhere for backfill. If traces of contaminants are still present, the material may be run through the soil washing unit again or collected for alternate treatment or off-site disposal.

Off-site disposal may be regulated by the Resource Conservation Recovery Act

(RCRA) or the Toxic Substance Control Act (TSCA).

The silt and clay in the washwater are allowed to settle out, thereby separating these materials from the washwater. The silt and clay are then tested for the presence and concentration of contaminants. If all the contaminants were transferred to the washwater and the silt and clay are clean, the silt and clay can be used at the site as backfill. If still contaminated, the material may be run through the soil washing process again, or collected for alternate treatment or off-site disposal in a permitted RCRA or TSCA landfill.

The washwater, which now also contains the contaminants, is treated by wastewater treatment processes so it can be recycled for further use. As mentioned earlier, the washwater may contain additives, some of which may interfere with the wastewater treatment process. If this is the case, the additives must be removed or neutralized by "pretreatment" methods before the washwater goes to wastewater treatment.

The equipment is usually skid-mounted so that it is easily transported, thereby allowing the process to be conducted at the site. The larger scale soil washing equipment presently in use can process over 100 cubic yards of soil per day.

Why consider soil washing?

Soil washing can be used as a technology by itself, but is often used in combination with other treatment technologies. Perhaps the principal use of soil washing is as a volume reduction technique in which the contaminants are concentrated in a relatively small mass of material. The larger the percentage of coarse sand and gravel in the material to be processed (which can be cleaned and perhaps returned to the site), the more cost-effective the soil washing application will be.

Ideally, the soil washing process would lead to a volume reduction of about 90% (which means only 10% of the original volume would require further treatment). Wastes with a high percentage of fine silt and clay will require a larger quantity of material to go on to subsequent, more expensive treatment. These soils may not be good candidates for soil washing.

Soil washing is used to treat a wide range of contaminants, such as metals, and the organic contaminants found in gasoline, fuel oils, and pesticides. There are several advantages to using this technology. Soil washing:

- Provides a closed system that remains unaffected by external conditions. This system permits the control of the conditions (such as the pH level and temperature) under which the soil particles are treated.
- Allows soils containing hazardous chemicals to be excavated and treated on-site.
- Has the potential to remove a wide variety of chemical contaminants from soils.
- Is cost-effective because it can be employed as a pre-processing step, significantly reducing the quantity of material that would require further treatment by another technology. It also creates a more uniform material for subsequent treatment technologies.

Will soil washing work at every site?

Soil washing works best when the soil does not contain a large amount of silt or clay. In some cases, soil washing is best applied in combination with other treatment technologies, rather than as a technology by itself.

Where has soil washing been used?

At the King of Prussia site in New Jersey, soil washing was used to remove metal

contamination such as chromium, copper, mercury, and lead from 19,000 tons of soil and sludge at a former industrial waste reprocessing facility. The soil washing process was able to clean the materials to meet clean-up goals for eleven metals. For example, chromium levels went from 8,000 milligrams chromium per kilogram of soil (mg/kg) to 480 mg/kg. Soil washing has been used at numerous other sites, predominantly for the removal of metals, semi-volatile organic chemicals (SVOCs), and polycyclic aromatic hydrocarbons (PAHs).

The information in this fact sheet was taken from A Citizen's Guide to Soil Washing, A U.S. Environmental Protection Agency Publication, April 1996